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Two new species of the genus *Goniurosaurus* (Squamata: Sauria: Eublepharidae) from southern China

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Abstract

Two new species of large geckos in the genus *Goniurosaurus* are described based on specimens collected from karst areas of Guangxi Zhuang Autonomous Region, southern China: *Goniurosaurus kadoorieorum* **sp. nov.** and *Goniurosaurus kwangsiensis* **sp. nov.** Data on natural history of the new species are provided, as well as discussions on the current conservation status of *Goniurosaurus* species in southern China. Due to the popularity of this genus as novelty pets, and recurring cases of scientific descriptions driving herpetofauna to near-extinction by commercial collectors, we do not disclose the collecting localities of these restricted-range species in this publication. However, such information has been presented to relevant government agencies, and is available upon request by fellow scientists.

Key words: Eublepharidae, *Goniurosaurus*, new species, taxonomy, Guangxi, Southern China

Introduction

The eublepharid genus *Goniurosaurus* occurs throughout southern East Asia with disjunct geographic distribution; species are known from northeastern Vietnam including Cat Ba Island, southern China including Hainan Island, and the Ryukyu Archipelago of Japan (Wang *et al.* 2014). Herpetofaunal surveys in northern Vietnam and southern China resulted in the discovery of eight new *Goniurosaurus* species in the past two decades (Grismer *et al.* 1999, 2002; Orlov *et al.* 2008; Ziegler *et al.* 2008; Wang *et al.* 2010, 2013, 2014), and in a phylogenetic study of *Goniurosaurus* species in the Ryukyu Archipelago, Honda *et al.* (2014) reported the presence of two undescribed taxa within the *Goniurosaurus kuroiwae* species group; these studies indicate species diversity of the genus *Goniurosaurus* is still underestimated. Based on morphological and phylogenetic studies, 15 taxa within four major species groups are widely recognized at present (Grismer *et al.* 1999, 2002; Honda *et al.* 2014; Wang *et al.* 2013, 2014): (1) the *G. lichtenfelderi* group composed of *G. lichtenfelderi* (Mocquard) from northern Vietnam and *G. hainanensis* Barbour from Hainan Island; (2) the *G. kuroiwae* group composed of five taxa from the Ryukyu Archipelago of Japan; (3) the *G. luii* group composed of *G. araneus* Grismer, Viets & Boyle from northeastern Vietnam and southwestern Guangxi, *G. bawanglingensis* Grismer, Shi, Orlov & Ananjeva from Hainan Island, *G. catbaensis* Ziegler, Nguyen, Schmitz, Stenke & Rösler from Cat Ba Island of Vietnam, *G. huuliensis* Orlov, Ryabov, Nguyen, Nguyen & Ho from northern Vietnam, *G. liboensis* Wang, Yang & Grismer from the border region between Guangxi and Guizhou Provinces and *G. luii* Grismer, Viets & Boyle from southwestern Guangxi; and (4) the *G. yingdeensis* group composed of *G. yingdeensis* Wang, Yang & Cui and *G. zhelongi* Wang, Jin, Li & Grismer from northwestern Guangdong. As listed, seven species are hitherto recorded from China.

The first record of the genus *Goniurosaurus* from Guangxi was reported by Wen (1983), which was identified as "*G. lichtenfelderi*" in all early accounts of the genus from China (Li *et al.* 1995; Zhao & Adler 1993; Zhao *et al.* 1999). But it is now believed that *G. lichtenfelderi* only occurs in northern Vietnam (Ziegler *et al.* 2008; Wang *et al.* 2014). Two new species, *G. luii* and *G. liboensis*, were later described from Guangxi by Grismer *et al.* (1999) and Wang *et al.* (2013), respectively. With the discovery of *G. araneus* from Guangxi by Chen *et al.* (2014), three members of *Goniurosaurus*, all karst specialists, are now confirmed to occur in Guangxi. During our field surveys

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in Guangxi over the past two years, several populations of *Goniurosaurus* species were discovered in various localities. Later morphological study has revealed that there are two new unidentified taxa within the new material, which can be distinguished from all known congeners by a combination of morphological characters. Herein, we describe these two unknown taxa as new species.

Material and methods

All specimens are preserved in 80% alcohol and temporarily deposited at the herpetological collection of Kadoorie Farm and Botanic Garden, Hong Kong (KFBG). Measurements were taken with digital caliper to the nearest 0.1 mm. Measurements are as follows: snout vent length (SVL) from tip of snout to vent; tail length (TaL) from vent to tip of tail; distance between axilla and groin (AG) from posterior edge of forelimb insertion to anterior edge of hindlimb insertion; snout to eye distance (SE) measured from tip of snout to anteriormost point of eye; eye to ear distance (EE) from posterior margin of eye to posterior margin of ear; maximum head width (HW); head length (HL) from tip of snout to posterior margin of ear. Scalation characters are as follows: supralabials (SPL); infralabials (IFL); nasal scales surrounding nare (N); internasals (IN); gular scales bordering the internasals (PostIN); postmentals (PM); gular scales bordering the postmentals (GP); eyelid fringe scales or ciliaria (CIL); preorbital scales (PO); granular scales surrounding dorsal tubercles (GST); dorsal tubercle rows at midbody (DTR); paravertebral tubercles between limb insertions (TL); scales around midbody (MB); subdigital lamellae under the first finger (LF1) and the fourth finger (LF4); subdigital lamellae under the first toe (LT1) and the fourth toe (LT4); precloacal pores (PP); postcloacal tubercles (PAT). Bilateral scale counts were given as left/right.

Systematics

***Goniurosaurus kadoorieorum* sp. nov.**
Figs. 1–2, 5

Holotype. KFBG 14032, adult male, from Guangxi Zhuang Autonomous Region, China; exact locality withheld; available to qualified researchers upon request. Collected on 18 May 2014 by J.H. Yang.

Paratypes. Four paratypes: one adult male KFBG 14031; one adult female KFBG 14033; one sub-adult male KFBG 14034; one juvenile male KFBG 14035; data identical to the holotype. Coordinates and other standard collecting information were recorded for each type and kept in the KFBG herpetological collection catalog.

Diagnosis. *Goniurosaurus kadoorieorum* **sp. nov.** can be distinguished from other congeners by a combination of the following characters: relatively greater SVL (112.0–118.0 mm in adults); nuchal loop wide, posteriorly protracted; three wide nearly immaculate body bands between limbs insertions, bordered by wide dark bands anteriorly and posteriorly; ground color mottled in adults; dark brown spots on lateral belly; mental shield with a dark blotch; iris blood red in juvenile, orange red in sub-adult, and a remarkable olive green in adults; enlarged supraorbital tubercles present; axillary pockets deep; internasals two; eight or nine nasal scales surrounding naris; 47–55 eyelid fringe scales; 9–11 supralabials, nine infralabials; 124–132 midbody scale rows; 26–28 precloacal pores in males; claws sheathed by four scales, lateral two long and curved; one or two postcloacal tubercles.

Description of holotype. KFBG 14032, adult male; SVL 118.0 mm; TaL (regenerated) 69.5 mm; AG 55.6 mm; SE 12.4 mm; EE 10.9 mm; HW 20.4 mm; HH 12.8 mm; HL 30.5 mm; SVL : AG 2.12; SVL : HL 3.87; HL : HW 1.50; HL : HH 2.38; SE : EE 1.14; head triangular, wider than neck, covered with uniform granular scales interspersed with tubercles in the temporal and occipital regions; scales of rostrum slightly larger and flatter than between orbits; conspicuous row of enlarged supraorbital tubercles; rostral wider than height, middorsal portion of rostral partially sutured dorsomedially, bordered laterally by first supralabial and prenasal, dorsolaterally by supranasal, and dorsally by two internasals; internasals about the same size as scales behind them; external nares bordered by eight nasals each: anteriorly by prenasal, dorsally by supranasal and one granular scale, posteriorly by four smaller granular scales, and ventrally by the prenasal and one smaller granular scale; prenasals with long recurved ventral portion; supranasals triangular, separated by two internasals; supralabials 10/11, grading into granular scales posteriorly; eyes relatively large, pupils vertical; eyelid fringe scales 53/52, those of upper eyelid

enlarged; outer surface of upper eyelid composed of granular scales about the same size of those on top of head; a fold of skin originating in the suborbital region extends posteroventrally across the angle of the jaw; external auditory meatus elliptical with long axis directed dorsoventrally; tympanum deeply recessed; mental triangular, bordered laterally by first infralabial and posteriorly by five postmentals; postmentals bordered by 11 gular scales; infralabials nine / nine, grading posteriorly into smaller scales; gular scales juxtaposed and granular, abruptly grading posteriorly into flat hexagonal pectoral scales and even larger ventral scales. Neck narrower than body, covered with uniform granular scales interspersed with conical tubercles on nape; tubercles on flanks conical, those of vertebral region somewhat lower in profile; body tubercles not increasing in size posteriorly, grading into somewhat more pointed caudal tubercles; dorsal body tubercles surrounded by 11–13 granular scales (usually 12); 23 dorsal tubercle rows at midbody; 34 paravertebral tubercles between limb insertions, distinct vertebral row of scales absent. Body relatively long and thin, covered with granular scales grading ventrally into larger hexagonal flattened subimbricate ventral scales; 124 scales around midbody; larger ventral scales grade abruptly into smaller granular scales immediately anterior to the vent at the level of the precloacal pores; 26 precloacal pores in a continuous transverse series extending on to the basal portion of the thighs; region posterior to vent covered with flat juxtaposed scales and greatly swollen, containing one enlarged postcloacal tubercle laterally on each side at the level of the vent. Limbs relatively long and thin, covered dorsally with granular scales interspersed with several tubercles and ventrally with flat, juxtaposed to subimbricate scales; dorsal granular scales grade into slightly flattened subimbricate scales on top of pes and manus; tubercles present on top of pes, lacking on top of manus; hind limbs slightly larger than forelimbs; larger granular scales on ventral surfaces of pes and manus; deep axillary pockets present; subdigital lamellae wide, 11/10 on first finger, 19/18 on fourth finger, as well as 11/11 on first toe, 21/22 on fourth toe; digits laterally compressed, increasing in length from first to fourth, fifth shorter than fourth; base of claws sheathed by four scales, two lateral scales long and curbed. Tail regenerated; narrow at base with four whorls, abruptly thickening posteriorly, and gradually narrowing to the tip; the third caudal whorl eight scale rows in width, containing six sharply pointed conical tubercles in a transverse row; dorsal granular scales larger in regenerated portion of tail and 2–4 times the size of dorsal body scales; subcaudals flat, smooth, larger than dorsal caudals, imbricate at whorl, posteriorly juxtaposed.

Coloration in life. Dorsal ground color of head, body and limbs greyish lilac and mottled with irregularly shaped dark brown blotches; iris olive green, somewhat yellowish near pupil; wide posteriorly protracted nuchal loop, somewhat posteriorly inflected, anterior ends inserting on lower eyelids, edged dorsally and ventrally in wide dark brown; four wide nearly immaculate body bands, three on body between limb insertions, and another one on tail base, all edged anteriorly and posteriorly by wide dark brown bands; the nuchal loop and four body bands nearly same color as ground color but somewhat brighter yellow; infralabials and sublabials cream-colored with few dark brown spots; ventral surfaces of head, body and limbs dull white and nearly immaculate except for few dark brown spots on lateral throat, limbs and lateral belly and a dark brown blotch present in the mental shield; ground color of the regenerated tail dark brown, one immaculate caudal band not completely encircling the tail, followed by irregularly shaped white markings (Fig. 1).

Variation. For measurements and scalation data of the type series see Table 1. All male types have 26–28 distinct precloacal pores, absent in the female paratype KFBG 14033; postcloacal tubercle distinctly enlarged in male types, relatively smaller in the female paratype; internasals about the same size of those behind them in KFBG 14031–32, 14034, but larger in KFBG 14033 and 14035. Both adult paratypes KFBG 14031 and 14033 largely match the coloration of the holotype. The sub-adult paratype KFBG 14034 has a more lilac ground color and orange nuchal loop and body bands; the juvenile paratype KFBG 14035 has a grey-purple immaculate ground color, light orange nuchal loop and body bands, and an immaculate venter. Only the juvenile paratype KFBG 14035 has an original tail that is cylindrical and posteriorly gradually narrowing to the tip, with seven immaculate white bands, white caudal bands are complete ventrally except for the first. Iris color is olive green in all three adult types, whereas it is orange red in the subadult paratype KFBG 14034, and blood red in the juvenile paratype KFBG 14035 (Fig. 2).

Comparison. *Goniurosaurus kadoorieorum* **sp. nov.** distinctly differs from all other known species of the genus *Goniurosaurus* by having an olive green iris in adults as opposed to an ivory, yellow, orange or blood-red iris.

TABLE 1. Measurements (in mm) and scalation characters of the type specimens of *Goniurosaurus kadoorieorum* **sp. nov.** (Abbreviations defined in text).

	Holotype	Paratypes			
	KFBG 14032	KFBG 14031	KFBG 14033	KFBG 14034	KFBG 14035
Sex	Adult male	Adult male	Adult female	Sub-adult male	Juvenile male
SVL	118.0	112.5	116.0	106.0	68.9
TaL	69.5*	–	63.4*	–	59.8
AG	55.6	54.5	54.3	51.6	30.5
HL	30.5	29.2	29.5	26.6	18.3
HW	20.4	21.0	19.8	17.7	12.5
HH	12.8	13.3	12.3	11.5	8.3
SE	12.4	12.6	12.4	11.4	7.6
EE	10.9	10.1	10.6	9.4	6.5
SVL:TaL	–	–	–	–	1.15
SVL:HL	3.87	3.85	3.93	3.98	3.77
SVL:AG	2.12	2.06	2.14	2.05	2.26
HL:HW	1.50	1.39	1.49	1.50	1.46
SE:EE	1.14	1.25	1.17	1.21	1.17
SPL	10/11	10/11	10/10	11/10	10/10
IFL	9/9	9/9	9/9	9/9	9/9
N	7/6	6/6	6/6	6/6	6/7
IN	2	2	2	2	2
PostIN	3	5	6	3	9
PM	5	5	5	5	4
GP	11	10	11	8	8
PO	17/16	16/15	16/17	18/19	16/17
CIL	53/52	48/47	51/54	52/55	51/54
MB	124	130	132	131	129
GST	11–13	11–13	11–13	11–13	11–13
TL	34	30	32	33	34
DTR	23	22	24	23	24
LF1	11/10	10/10	10/10	10/10	11/10
LF4	19/18	17/17	19/17	17/18	18/18
LT1	11/11	11/10	10/10	11/11	10/11
LT4	21/22	23/21	23/22	23/24	22/22
PP	26	26	absent	28	27
PAT	1/1	1/1	2/1	1/2	2/2

* Regenerated tail.

It differs from the *G. kuroiwae* species group by having an enlarged row of supraorbital tubercles (*versus* absent in the *kuroiwae* group), having deep axillary pockets (*versus* absent in the *kuroiwae* group), having the nuchal loop posteriorly protracted and lying on the nape of the neck (*versus* nuchal loop round posteriorly and on the occiput in the *kuroiwae* group), having 26–28 precloacal pores (*versus* lacking precloacal pores in the *kuroiwae* group), having claws sheathed by four scales (*versus* claws unsheathed in the *kuroiwae* group) and a different coloration; it differs from the *G. lichtenfelderi* group (*G. lichtenfelderi* and *G. hainanensis*) by having an enlarged row of supraorbital tubercles (*versus* absent in the *lichtenfelderi* group), deep axillary pockets (*versus* no such pockets in the *lichtenfelderi* group), having the nuchal loop posteriorly protracted and lying on the nape of the neck

(*versus* nuchal loop round posteriorly and on the occiput in the *lichtenfelderi* group), having three transverse bands between axilla and groin (versus two in the *lichtenfelderi* group) and a different coloration; it differs from *G. yingdeensis* and *G. zhelongi* by having the nuchal loop posteriorly protracted (*versus* round posteriorly in *yingdeensis* and *zhelongi*), having lateral scales of claw sheaths long and curved (*versus* short and conchoidal in *yingdeensis* and *zhelongi*), 26–28 precloacal pores (*versus* 10–13 precloacal pores in *yingdeensis*, 9 in *zhelongi*) and a different coloration.

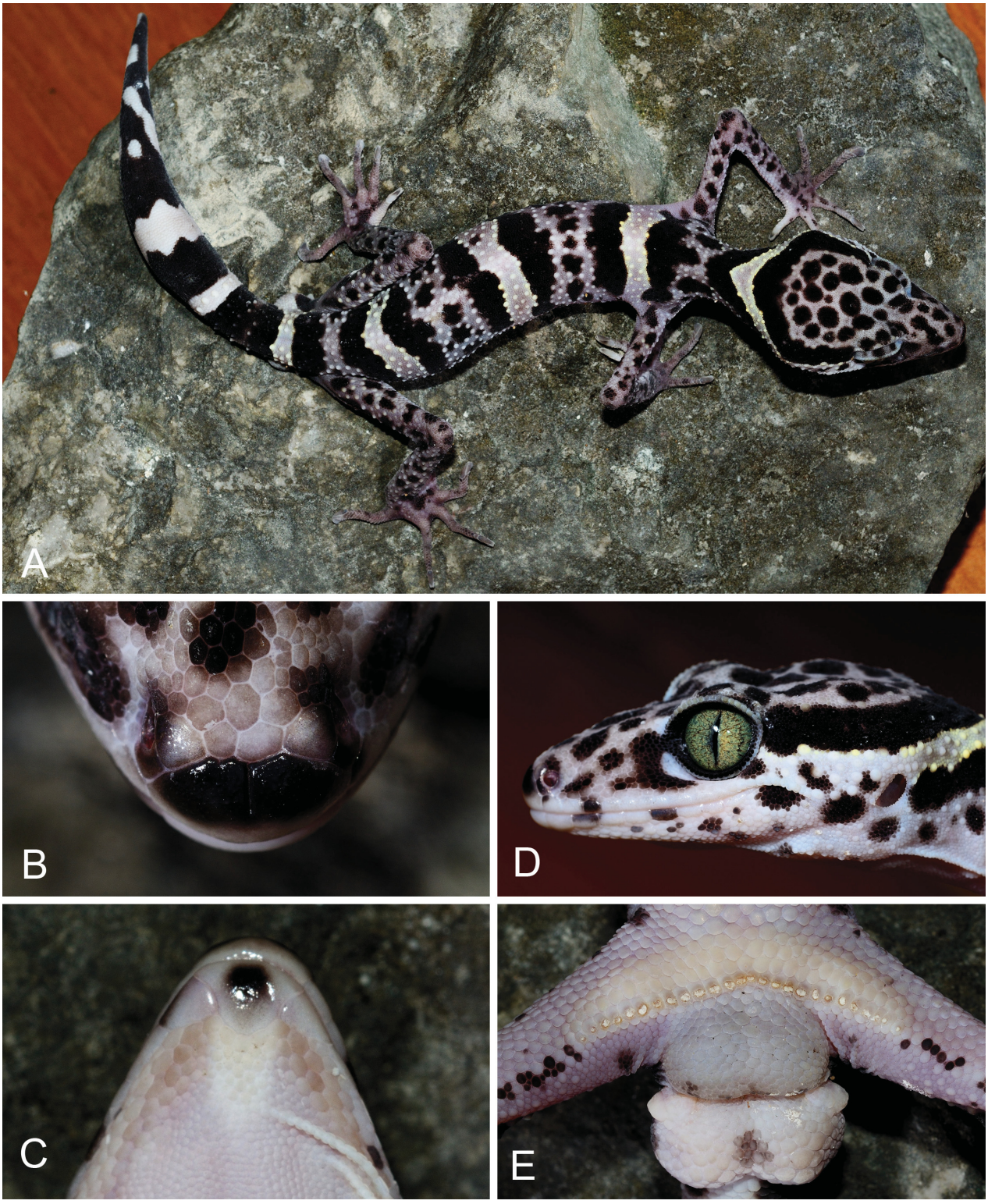

FIGURE 1. Holotype of *Goniurosaurus kadoorieorum* **sp. nov.**, KFBG 14032 in life: A: dorsal view of body and tail; B: dorsal view of snout tip; C: ventral view of chin; D: lateral view of the head; E: precloacal region.

FIGURE 2. *Goniurosaurus kadooireorum* **sp. nov.**: A: sub-adult male paratype, KFBG 14034; B: juvenile male paratype, KFBG 14035.

By having a posteriorly protracted nuchal loop and deep axillary pockets, *G. kadoorieorum* **sp. nov.** can be placed in the *G. luii* species group (comprising *G. araneus*, *G. bawanglingensis*, *G. catbaensis*, *G. huuliensis*, *G. liboensis* and *G. luii*). *G. kadoorieorum* **sp. nov.** differs from these six species by having enlarged row of supraorbital tubercles (*versus* absent in *bawanglingensis*), tubercles between orbits present (*versus* absent in *araneus*, *catbaensis* and *huuliensis*), two internasals (*versus* internasal one in *huuliensis*, lacking in *catbaensis*);

granular scales of upper eyelid equal in size to those on the top of head (*versus* one-half the size in *araneus* and *luii*); 26–28 precloacal pores (*versus* 18–23 in *araneus*, 37–46 in *bawanglingensis*, 16–21 in *catbaensis*, 23 in *liboensis*), infralabials and sublabials mottled (*versus* immaculate in *araneus* and *bawanglingensis*), dark spot on mental scale present (*versus* absent in *araneus*, *bawanglingensis* and *liboensis*), body bands much wider (*versus* relatively narrow in *bawanglingensis*, *catbaensis*, *huuliensis*, *liboensis* and *luii*), body bands nearly immaculate (*versus* mottled with dark spotting in *bawanglingensis*), adult ground color mottled (*versus* nearly immaculate in *araneus*), lateral spotting on belly present (*versus* absent in *araneus*, *bawanglingensis* and *liboensis*), and a remarkable olive green iris in adults (*versus* orange, brown or red in these six species).

Etymology. The new species, "*kadoorieorum*", is named in honour of the Kadoorie brothers, Sir Horace and Lord Lawrence, from Hong Kong, for their life-long support to biodiversity research and conservation in the region. As a common name we suggest "Kadoories' Cave Gecko".

Natural history and distribution. *Goniurosaurus kadoorieorum* **sp. nov.** is currently only known from its type locality in Guangxi Zhuang Autonomous Region in southern China. The new species appears to be a nocturnal karst specialist; all individuals were found amongst limestone rocks in karst forest at night.

***Goniurosaurus kwangsiensis* sp. nov.**
Figs. 3–5

Holotype. KFBG 14052, adult male, from Guangxi Zhuang Autonomous Region, China; exact locality withheld; available to qualified researchers upon request. Collected on 5 July 2013 by J.H. Yang.

Paratypes. Three paratypes: two adult females KFBG 14050–51; one adult male KFBG 14053; data identical to the holotype. Coordinates and other standard collecting information were recorded for each type and kept in the KFBG herpetological collection catalog.

Diagnosis. *Goniurosaurus kwangsiensis* **sp. nov.** can be distinguished from other congeners by a combination of following characters: medium body size (SVL 97.6–109.1 mm in adults); nuchal loop narrow, posteriorly protracted; three narrow immaculate body bands between limbs insertions, bordered by wide dark bands anteriorly and posteriorly; ground color mottled in adults; dark brown spots on lateral belly absent; mental shield immaculate; iris light orange yellow; supraorbital tubercles slightly enlarged; axillary pockets deep; internasals one or two (usually one); eight or nine nasal scales surrounding naris; 52–58 eyelid fringe scales; 8–10 supralabials, 7–9 infralabials; 122–128 midbody scale rows; 31–33 distinct precloacal pores in males; claws sheathed by four scales, lateral two long and curved; one or two postcloacal tubercles (usually two).

Description of holotype. KFBG 14052, adult male; SVL 104.9 mm; TaL 92.8 mm; AG 46.8 mm; SE 11.2 mm; EE 8.7 mm; HW 19.2 mm; HH 11.5 mm; HL 27.3 mm; SVL : AG 2.24; SVL : HL 3.84; HL : HW 1.42; SE : EE 1.29; head triangular, wider than neck, covered with uniform granular scales interspersed with tubercles in the temporal and occipital regions; scales of rostrum slightly larger and flatter than between orbits; conspicuous row of slightly enlarged supraorbital tubercles; rostral wider than high, middorsal portion of rostral partially sutured dorsomedially, bordered laterally by first supralabial and prenasal, dorsolaterally by supranasal, and dorsally by one small internasal; internasal about the same size as scales behind them; external nares bordered by eight nasals each: anteriorly by prenasal, dorsally by supranasal and one granular scales, posteriorly by four smaller granular scales, and ventrally by the prenasal and one smaller granular scale; prenasals with long recurved ventral portion; supranasals triangular, separated by one internasal; supralabials 9/10, grading into granular scales posteriorly; eyes relatively large, pupils vertical; eyelid fringe scales 55/53, those of upper eyelid enlarged; outer surface of upper eyelid composed of granular scales about the same size of those on top of head; a fold of skin originating in the suborbital region extends posteroventrally across the angle of the jaw; external auditory meatus elliptical, with long axis directed dorsoventrally; tympanum deeply recessed; mental triangular, bordered laterally by first infralabial and posteriorly by three postmentals; postmentals bordered by nine gular scales; infralabials 7/8, grading posteriorly into smaller scales; gular scales juxtaposed and granular, abruptly grading posteriorly into flat hexagonal pectoral scales and even larger ventral scales. Neck narrower than body, covered with uniform granular scales interspersed with conical tubercles on nape; tubercles on flanks conical, those of vertebral region somewhat lower in profile; body tubercles not increasing in size posteriorly, grading into somewhat more pointed caudal tubercles; dorsal body tubercles surrounded by 11–13 granular scales (usually 11); 22 dorsal tubercle rows at

midbody; 27 paravertebral tubercles between limb insertions, distinct vertebral row of scales absent. Body relatively long and thin, covered with granular scales grading ventrally into larger hexagonal flattened subimbricate ventral scales; 128 scales around midbody; larger ventral scales grade abruptly into smaller granular scales immediately anterior to the vent at the level of the precloacal pores; 31 precloacal pores in a continuous transverse series extending on to the base of the thighs; region posterior to vent covered with flat juxtaposed scales and greatly swollen, containing two enlarged postcloacal tubercles laterally on each side at the level of the vent. Limbs relatively long and thin, covered dorsally with granular scales interspersed with several tubercles and ventrally with flat juxtaposed to subimbricate scales; dorsal granular scales grade into slightly flattened subimbricate scales on top of pes and manus; tubercles present on top of pes, lacking on top of manus; hind limbs slightly larger than forelimbs; larger granular scales on ventral surfaces of pes and manus; axillary pockets deep; subdigital lamellae wide, 10/10 on first finger, 18/19 on fourth finger, 11/12 on first toe, 24/23 on fourth toe; digits laterally compressed, increasing in length from first to fourth, fifth shorter than fourth; base of claws sheathed by four scales, two lateral scales long and curved. The original tail long and thin, thickest at base, anteriorly with whorls, posteriorly gradually narrowing to the tip; the third caudal whorl eight scale rows in width, incorporating four sharply pointed conical tubercles in a transverse row; dorsal granular scales of tail flat, smooth, about twice the size of dorsal body scales, arranged in more or less transverse rows; subcaudals flat, smooth, larger than dorsal caudals, imbricate at whorl, posteriorly juxtaposed.

Coloration in life. Dorsal ground color of head, body and limbs yellowish brown and mottled with irregularly shaped dark brown blotches; iris orange yellow; narrow slightly posteriorly protracted nuchal loop, anterior ends terminating at corners of mouth, edged dorsally and ventrally by wide dark brown margin; four narrow, nearly immaculate body bands, three on body between limb insertions, and another one on tail base, all edged anteriorly and posteriorly by wide, dark brown bands; the nuchal loop and four body bands light yellow; infralabials and supralabials dull white with few dark brown spots; ventral surfaces of head, body and limbs dull white and nearly immaculate except for few indistinct dark brown spots on limbs and lateral throat; mental shield immaculate; ground color of the original tail dark brown with five immaculate white caudal bands completely encircling the tail, and a white tip (Fig. 3).

Variation. For measurements and scalation data of the type series see Table 2. All three adult paratypes largely match the overall scalation and coloration characters of the holotype. Both two male types have 26–27 distinct precloacal pores, whereas precloacal pores are present but indistinct in two female types; postcloacal tubercle distinctly enlarged in males, relatively smaller in females; internasal usually single, two in the paratype 14053. A sub-adult female individual was recorded (not captured) during the survey. It had a paler ground color, fewer dark spots or blotches on body, and dark blotches on dorsum of head somewhat smaller and more rounded than in adults (Fig. 4).

Comparison. *Goniurosaurus kwangsiensis* **sp. nov.** differs from the *G. kuroiwae* species group by having an enlarged row of supraorbital tubercles (*versus* absent in the *kuroiwae* group), having deep axillary pockets (*versus* no such pockets in the *kuroiwae* group), having nuchal loop posteriorly protracted and lying on the nape of the neck (*versus* nuchal loop round posteriorly and on the occiput in the *kuroiwae* group), having 31–33 precloacal pores (*versus* lacking precloacal pores in the *kuroiwae* group), having claws are sheathed by four scales (*versus* claws unsheathed in the *kuroiwae* group) and a different coloration; it differs from the *G. lichtenfelderi* species group (*G. lichtenfelderi* and *G. hainanensis*) by having an enlarged row of supraorbital tubercles (*versus* absent in the *lichtenfelderi* group), having deep axillary pockets (versus no such pockets in the *lichtenfelderi* group), having the nuchal loop posteriorly protracted and lying on the nape of the neck (*versus* nuchal loop round posteriorly and on the occiput in the *lichtenfelderi* group), having three transverse bands between axilla and groin (*versus* two in *lichtenfelderi* group) and a different coloration; it differs from *G. yingdeensis* and *G. zhelongi* by having nuchal loop posteriorly protracted (*versus* round posteriorly in *yingdeensis* and *zhelongi*), having lateral scales of claw sheaths long and curved (*versus* short and conchoidal in *yingdeensis* and *zhelongi*), 32 precloacal pores (versus 10–13 precloacal pores in *yingdeensis*, 9 in *zhelongi*), and a different coloration.

By having a posteriorly protracted nuchal loop and deep axillary pockets, *G. kwangsiensis* **sp. nov.** can be placed in the *G. luii* species group (comprising *G. araneus*, *G. bawanglingensis*, *G. catbaensis*, *G. huuliensis*, *G. kadoorieorum* **sp. nov.**, *G. liboensis* and *G. luii*). *Goniurosaurus kwangsiensis* **sp. nov.** differs from these seven species by having an enlarged row of supraorbital tubercles (*versus* absent in *bawanglingensis*), tubercles between orbits present (*versus* absent in *araneus*, *catbaensis* and *huuliensis*), one (rarely two) internasal (*versus* internasal

lacking in *catbaensis*, two in *kadoorieorum* and two or three in *liboensis*), granular scales of upper eyelid equal in size of those on the top of head (*versus* one-half the size in *araneus* and *luii*), 31–33 precloacal pores (*versus* 18–23 in *araneus*, 37–46 in *bawanglingensis*, 16–21 in *catbaensis*, 25–28 in *huuliensis*, 26–28 in *kadoorieorum*, 23 in *liboensis* and 23–29 in *luii*), infralabials and supralabials mottled (*versus* immaculate in *bawanglingensis*), dark blotch on mental shield absent (*versus* present in *huuliensis*, *kadoorieorum* and *luii*), body bands narrow (*versus* relatively wider in *araneus* and *kadoorieorum*), body bands immaculate (*versus* mottled with dark spotting in *bawanglingensis*), adult ground color mottled (*versus* nearly immaculate in *araneus*), lateral spotting on belly absent (*versus* present in *catbaensis*, *huuliensis*, *kadoorieorum* and *luii*), and iris orange yellow in adults (versus brown in *araneus*, red brown in *huuliensis*, and olive green in *kadoorieorum*).

TABLE 2. Measurements (in mm) and scalation characters of the type specimens of *Goniurosaurus kwangsiensis* **sp. nov.** (Abbreviations defined in text).

	Holotype	Paratypes		
	KFBG 14052	KFBG 14050	KFBG 14051	KFBG 14053
Sex	Adult male	Adult female	Adult female	Adult male
SVL	104.9	109.1	97.6	103.1
TaL	92.8	89	75.3	66.6*
AG	46.8	48.3	45.9	46.1
HL	27.3	28.4	24.9	27.6
HW	19.2	19.3	17.5	19.4
HH	11.5	11.4	11.3	12
SE	11.2	11.5	10.1	11.7
EE	8.7	8.6	7.9	8.7
SVL:TaL	1.13	1.23	1.30	–
SVL:HL	3.84	3.84	3.92	3.74
SVL:AG	2.24	2.26	2.13	2.24
HL:HW	1.42	1.47	1.42	1.42
SE:EE	1.29	1.34	1.28	1.34
SPL	9/10	8/10	10/9	10/9
IFL	7/8	9/8	9/9	8/9
N	6/6	6/6	6/6	7/7
IN	1	1	1	2
PostIN	1	2	2	2
PM	3	3	6	4
GP	9	7	8	8
PO	19/18	15/15	17/16	18/18
CIL	55/53	52/54	54/55	55/58
MB	128	127	122	124
GST	11–13	10–12	10–12	11–13
TL	27	32	32	30
DTR	22	20	21	21
LF1	10/10	11/11	11/11	11/12
LF4	18/19	19/19	18/19	21/21
LT1	11/12	12/12	12/11	13/12
LT4	24/23	23/24	24/22	26/27
PP	31	indistinct	indistinct	33
PAT	2/2	2/2	2/2	2/1

* Regenerated tail.

Etymology. The specific epithet "*kwangsiensis*" is named after its type locality, Guangxi Zhuang Autonomous Region, China (Kwangsi is the former official name of Guangxi). For the common name, we suggest "Guangxi Cave Gecko".

Natural history and distribution. Specimens of the new species were found in karst forest at night. A total of nine individuals were found including four adult females, four adult males and one sub-adult; four were collected and assigned as the type series. A gravid adult female containing three well-developed eggs was among the nine seen but not collected. Three eggshells, most likely of *G. kwangsiensis* **sp. nov.**, were also found in a rock crevice. Sympatric herpetofauna recorded in the locality during the survey included Asian Common Toad *Duttaphrynus melanostictus* (Schneider), King Cobra *Ophiophagus Hannah* (Cantor), and White-spotted Slug Snake *Pareas margaricophorus* (Jan).

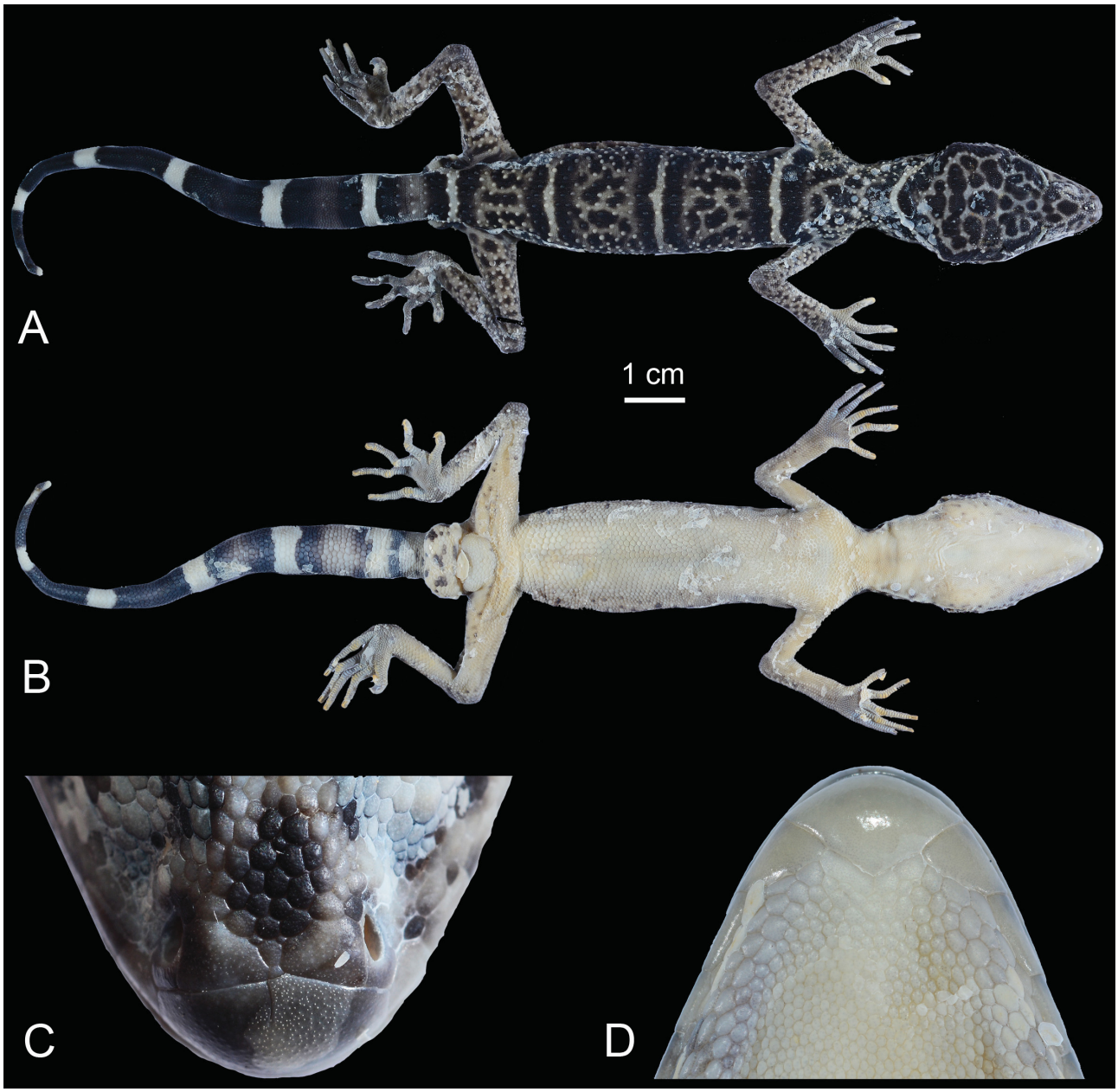

FIGURE 3. Holotype of *Goniurosaurus kwangsiensis* **sp. nov.**, KFBG 14052 in preservative: A: dorsal view of body and tail; B: ventral view of body and tail; C: dorsal view of snout tip; D: ventral view of chin.

FIGURE 4. *Goniurosaurus kwangsiensis* **sp. nov.**: A: a sub-adult female from the type locality; B: adult female paratype, KFBG 14050; C: lateral view of the head of KFBG 14050.

FIGURE 5. The six known species of the *Goniurosaurus luii* species group from China. A: a female individual of *G. kwangsiensis* **sp. nov.** from Guangxi; B: paratype KFBG 140334 of *G. kadoorieorum* **sp. nov.** from Guangxi; C: adult female of *G. araneus* from Guangxi; D: subadult male of *G. bawanglingensis* from Hainan; E: adult female of *G. luii* from Guangxi; F: holotype SYS r000218 of *G. liboensis* from Guizhou.

Discussion

Cave geckos of the genus *Goniurosaurus* have been very popular in the pet market since the 1990s. According to our long-term monitoring in local pet markets as well as hobbyists' websites on the Internet, almost all *Goniurosaurus* species are inevitably traded (see http://www.geckotime.com/three-to-get-ready-goniurosaurus/); some rarities are fetching an alarmingly high price, giving traders great incentive for excessive collection. Such phenomenon has been reported by Stuart *et al.* (2006) who argued that the conventional practice of giving the exact collecting locality for the formal description of new species would probably put those species with high commercial value at high risk. They gave the example of *G. luii* which has been overexploited to the point of local extirpation at its type locality after it had been formally described. They highlighted *Goniurosaurus* species as taxa likely to become commercial commodities, and called for caution in disclosing exact localities in describing new species. Hou *et al.* (2014) also reported similar cases of poaching on restricted-range herpetofauna for the pet market following disclosure of locality information in formal publications.

During our recent survey in Longzhou county and Pingxiang City of Guangxi (type localities of *G. luii*), local villagers in some areas mentioned that some outsiders paid them to collect live individuals of *Goniurosaurus* species in large quantities. Naturally, species of *Goniurosaurus* are habitat-specialists living in low density in the wild, many of which have highly restricted ranges; the high demand from the pet trade is therefore a major threat to their survival. The impact of pet trade collection is exacerbated by habitat loss due to quarrying, as demand for cement and mine products is rising following rapid economic growth and urbanization throughout China. While one might argue sound legislation and management plans could tackle the problem of overexploitation of species with high commercial value (Stuart *et al.* 2006), in reality such intervention alone is insufficient to stop poaching in this part of the world, even for high-profile flagship species (Brook *et al.* 2014). With these considerations in mind, we decided to withhold detailed locality information of the two new species in this publication. Such information, however, has been submitted to relevant government agencies responsible for conservation in Guangxi, and fellow scientists are welcome to contact the authors for these data should it be deemed necessary.

One of the two new species described in this paper occurs outside a nature reserve, and currently no member in the genus *Goniurosaurus* is included in wildlife protection laws either in China and Vietnam, despite their high endemism and threat levels. Of the 17 taxa known today, only the *Goniurosaurus kuroiwae* species group (with five taxa) from Japan has been assessed by the IUCN Red List, and is listed as Endangered. It should be noted that the Ryukyu Archipelago is under considerably less threat from habitat degradation and poaching, and Japan as a whole is well advanced in terms of conservation management. We therefore feel that most of the *Goniurosaurus* species in southern China and Vietnam are at a similar threat level, if not more severe than the Japanese species. Thus, we strongly suggest that international trade of all species of the genus *Goniurosaurus* be regulated by CITES. We also call for the inclusion of all *Goniurosaurus* species in statutory wildlife protection list in their range countries.

With the description of two new species in the present paper, the total number of members of the genus *Goniurosaurus* is 17. Of the 17 species worldwide, nine occur in China and all but one, *G. araneus*, are endemic to China with highly restricted ranges, making China a hotspot for research and conservation of the genus.

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